WHAT IS CLAIMED IS:

1. A constant current output control method for a switching power supply circuit having a transformer provided with a primary winding and a secondary output winding; an oscillating switching device connected in-series with the primary winding to connect the primary winding to an energizing direct current power supply; a switching control circuit to execute ON/OFF control of the oscillating switching device; and a rectifying smoothing circuit to rectify and smooth an output of the secondary output winding; the constant current output control method for changing an ON/OFF time of the oscillating switching device of the switching power supply circuit, and executing a constant current output control of an output current I_{2o} of the rectifying smoothing circuit comprising:

deriving an OFF adjustment time T3 based on equation (1),

$$T3 = T2 \times (Np \div Ns \times Ipref \div 2 \div I_{2oset} - 1) - T1 \quad \cdots(1)$$

where, I_{2oset} represents a set output current of the rectifying smoothing circuit for which the constant current output control is to be executed, Np represents a number of turns of the primary winding, Ns represents a number of turns of the secondary output winding, T1 being a fixed time representing an ON time of the oscillating switching device to excite the primary winding during an oscillation period T, Ipref representing a reference peak current flowing in the primary winding when the ON time T1 completely elapses, and T2 representing an output time during which output is generated in the rectifying smoothing circuit;

controlling an OFF time of the oscillating switching device during the oscillation period T wherein the OFF time is equal to the sum of the output time T2 and the OFF adjustment time T3; and

setting the output current I_{2o} of the rectifying smoothing circuit to the set output current I_{2oset}.

2. A constant current output control method for a switching power supply circuit having a transformer provided with a primary winding and a secondary output winding; an oscillating switching device connected in-series with the primary winding so as to connect the primary winding to an energizing direct current power supply; a switching control circuit to execute ON/OFF control of the oscillating switching device at a fixed oscillation period T_c; and a rectifying smoothing circuit to rectify and smooth an output of the secondary output winding; the constant current output control method for changing an ON/OFF time of the oscillating switching device of the switching power supply circuit, and executing a constant current output control of an output current I_{2o} of the rectifying smoothing circuit, comprising the steps of:

detecting an output time T2 during which output is generated in the rectifying smoothing circuit;

deriving a set current I_{pset} based on equation (2),

$$I_{pset} = 2 \times Ns \div Np \times I_{2oset} \times T_c \div T2 \quad \cdots(2)$$

where, T_c represents the fixed oscillation period, I_{2oset} represents a set output current of the rectifying smoothing circuit for which the constant current output control is to be executed, Np represents a number of turns of the primary winding, and Ns represents a number of turns of the secondary winding;

adjusting an ON time T1 by stopping ON control of the oscillating switching device when a current Ip flowing in the primary winding reaches the set current I_{pset}; and

setting the output current I_{2o} of the rectifying smoothing circuit to the set output current I_{2oset}.

3. The constant current output control method for a switching power supply circuit according to claim 1 wherein the output time T2 during which output is generated in the rectifying smoothing circuit is detected based on a time from when a flyback

voltage is generated in the primary winding until when a first polarity reversal occurs.

4. The constant current output control method according to claim 1, wherein the output time T2 during which output is generated in the rectifying smoothing circuit is detected based on a time from when a flyback voltage is generated in an auxiliary winding of the transformer until when a first polarity reversal occurs.

5. A constant current output device for a switching power supply circuit having a transformer provided with a primary winding and a secondary output winding; an oscillating switching device connected in-series with the primary winding so as to connect the primary winding to an energizing direct current power supply; and a rectifying smoothing circuit to rectify and smooth an output of the secondary output winding; the constant current output device changing an ON/OFF time of the oscillating switching device of the switching power supply circuit, and executing a constant current output control of an output current I_{2o} of the rectifying smoothing circuit comprising:

a switching control circuit detecting a primary winding current Ip flowing in the primary winding following execution of ON control of the oscillating switching device, and executing OFF control of the oscillating switching device when a primary winding current Ip reaches a set reference peak current I_{pref};

an ON time detection portion detecting an ON time T1 of the oscillation switching device;

an output time detection portion that detects an output time T2 during which output is generated from the rectifying smoothing circuit; and

an adjustment time calculation circuit deriving an OFF adjustment time T3 from the reference peak current I_{pref}, the ON time T1 detected by the ON time detection portion, the output time T2 detected by the output time detection portion,

based on equation (1),

$$T3 = T2 \times (Np \div Ns \times Ipref \div 2 \div I2oset - 1) - T1 \quad \cdots(1)$$

where, I_{2oset} represents a set output current of the rectifying smoothing circuit for which the constant current output control is to be executed, Np represents a number of turns of the primary winding, and Ns represents a number of turns of the secondary winding, and wherein,

the switching control circuit executing ON control of the oscillating switching device when the OFF time has elapsed during an oscillation cycle T, the OFF time being the sum of the output time T2 and the OFF adjustment time T3, and sets the output current I_{2o} of the rectifying smoothing circuit to the set output current I_{2oset}.

6. A constant current output device for a switching power supply circuit comprising a transformer provided with a primary winding and a secondary output winding; an oscillating switching device connected in-series with the primary winding so as to connect the primary winding to an energizing direct current power supply; a switching control circuit executing ON/OFF control of the oscillating switching device at a fixed oscillation period T_c; and a rectifying smoothing circuit rectifying and smoothing an output of the secondary output winding; this constant current output device changing an ON/OFF time of the oscillating switching device of the switching power supply circuit, and executing a constant current output control of an output current I_{2o} of the rectifying smoothing circuit comprising:

a primary side current detection portion detecting a current Ip flowing in the primary winding;

an output time detection portion detecting an output time T2 during which output is generated in the rectifying smoothing circuit during an oscillation period T;

a set value calculation circuit that derives a set current I_{pset} from the output time T2 detected by the output time detection portion, according to equation,

$$Ipset = 2 \times Ns \div Np \times I2oset \times Tc \div T2 \cdots(2)$$

where, Tc represents the fixed oscillation period, $I2oset$ represents a set output current of the rectifying smoothing circuit for which the constant current output control is to be executed, Np represents a number of turns of the primary winding, and Ns represents a number of turns of the secondary winding; and

a current comparator comparing the current Ip flowing in the primary winding and the set current $Ipset$, wherein

the switching control circuit stopping ON control of the oscillating switching device when the current Ip reaches the set current $Ipset$, adjusting the ON time T1, and setting the output current $I2o$ of the rectifying smoothing circuit to the set output current $I2oset$.

7. The constant current output control device according to claim 5 further comprising:

a primary winding voltage monitoring circuit monitoring a voltage $V2a$ of the primary winding, and detecting a time from generation of a flyback voltage in the primary winding until a first polarity reversal, wherein

the time from generation of the flyback voltage in the primary winding until the first polarity reversal is taken to be output time T2.

8. The constant current output control device according to claim 5, further comprising:

an auxiliary winding further provided at the primary side of the transformer; and

an auxiliary winding voltage monitoring circuit monitoring a voltage $V2a$ of the primary winding, and detecting a time from generation of a flyback voltage in the auxiliary winding until a first polarity reversal, wherein

the time from generation of the flyback voltage in the auxiliary winding until

the first polarity reversal is taken to be output time T2.

9. The constant current output control device according to claim 5, further comprising:

an elapsed time estimation portion estimating an OFF elapsed time T3' for executing OFF control of the oscillating switching device (3), following elapse of the output time T2;

a calculation portion setting a comparison time $T2_{ref}$ by multiplying the output time T2 by $(Np \div Ns \times Ip_{ref} \div 2 \div I_{2oset} - 1)$; and

an OFF time comparator (97) setting potentials V_{T1}, $V_{T3'}$ and V_{T2ref} by respectively voltage converting, through multiplication by equal constants, the ON time T1 detected by the ON time detection portion, the OFF elapsed time T3' estimated by the elapsed time estimation portion, and the comparison time $T2_{ref}$ calculated by the calculation portion, and comparing the sum of the potentials $V_{T3'}$ and V_{T1} with V_{T2ref}, wherein

ON control of the oscillating switching device is executed when the sum of potentials $V_{T3'}$ and V_{T1} exceeds V_{T2ref}.

10. The constant current output control device according to claim 5 wherein the switching control circuit executes OFF control of the oscillation switching device when a current Ip' reaches the reference peak current Ip_{ref}, the current Ip' being derived from Equation,

$$Ip' = Ip + \delta t \times Vcc \div Lp \quad \cdots(3)$$

where, δt represents a time difference from detection of when the primary winding current Ip reaches the reference peak current Ip_{ref} until ON operation of the oscillating switching device is stopped, Vcc represents a power supply voltage of the direct current power supply, and Lp represents an inductance of the primary winding.

11. The constant current output control device for a switching power supply circuit according to claim 6, wherein the primary side current detection portion detects the current Ip based on a voltage drop V_{ip} from a resistance value $\underline{r_{ip}}$ of an Ip detection resistor that is connected in-series with the primary winding, and

the current comparator compares the voltage drop V_{ip} with a set potential V_{iset} that is a multiple of the set current I_{pset} and the resistance value $\underline{r_{ip}}$, and compares the current Ip to the set current I_{pset}.

12. The constant current output control device according to claim 6 wherein the current Ip' is taken as the current Ip and compared to the set current I_{pset}, this current Ip' being derived from Equation (3),

$$Ip' = Ip + \delta t \times Vcc \div Lp \quad \cdots(3)$$

where, δt is a time difference from detection of when the primary winding current Ip reaches the current I_{pset} until ON operation of the oscillating switching device is stopped, Vcc represents the power supply voltage of the direct current power supply, and Lp represents the inductance of the primary winding.

13. The constant current output control method for a switching power supply circuit according to claim 2 wherein the output time T2 during which output is generated in the rectifying smoothing circuit is detected based on a time from when a flyback voltage is generated in the primary winding until when a first polarity reversal occurs.

14. The constant current output control method according to claim 2, wherein the output time T2 during which output is generated in the rectifying smoothing circuit is detected based on a time from when a flyback voltage is generated in an auxiliary winding of the transformer until when a first polarity reversal occurs.

15. The constant current output control device according to claim 6 further comprising:

a primary winding voltage monitoring circuit monitoring a voltage V_{2a} of the primary winding, and detecting a time from generation of a flyback voltage in the primary winding until a first polarity reversal, wherein

the time from generation of the flyback voltage in the primary winding until the first polarity reversal is taken to be output time T2.

16. The constant current output control device according to claim 8, further comprising:

an auxiliary winding further provided at the primary side of the transformer; and

an auxiliary winding voltage monitoring circuit monitoring a voltage V_{2a} of the primary winding, and detecting a time from generation of a flyback voltage in the auxiliary winding until a first polarity reversal, wherein

the time from generation of the flyback voltage in the auxiliary winding until the first polarity reversal is taken to be output time T2.

17. The constant current output control device according to claim 9 wherein the switching control circuit executes OFF control of the oscillation switching device when a current Ip' reaches the reference peak current I_{pref}, the current Ip' being derived from Equation,

$$Ip' = Ip + \delta t \times Vcc \div Lp \quad \cdots(3)$$

where, δt represents a time difference from detection of when the primary winding current Ip reaches the reference peak current I_{pref} until ON operation of the oscillating switching device is stopped, Vcc represents a power supply voltage of the direct current power supply, and Lp represents an inductance of the primary winding.

18. The constant current output control device according to claim11 wherein the current Ip' is taken as the current Ip and compared to the set current Ip_{set}, this current Ip' being derived from Equation (3),

$$Ip' = Ip + \delta t \times Vcc \div Lp \quad \cdots(3)$$

where, δt is a time difference from detection of when the primary winding current Ip reaches the current Ip_{set} until ON operation of the oscillating switching device is stopped, Vcc represents the power supply voltage of the direct current power supply, and Lp represents the inductance of the primary winding.